

Final Project Report to the NYS IPM Program, Agricultural IPM - 2010

TITLE: REDUCING ONION THRIPS POPULATIONS IN ONION BY OPTIMIZING NITROGEN LEVELS AT PLANTING

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ABSTRACT:

Onion thrips continue to cause significant losses to New York's onion industry and alternative management strategies are needed. To address this issue, we sought to reduce thrips populations by minimizing nitrogen use while maintaining high bulb yields. Our results indicated season total numbers of onion thrips larvae could be reduced significantly (15 to 33%) if lower than recommended rates of nitrogen were applied at planting (50 to 60% of the standard rate of 125 lbs/acre). The total number of market-sized bulbs produced tended to increase with increasing levels of nitrogen and the greatest number of bulbs was produced in the treatment that received 150% of the standard amount of nitrogen applied at planting. However, there was a positive trend between the number of rotten bulbs at harvest and the amount of nitrogen applied at planting. We suspect that even more market-sized bulbs in the higher nitrogen treatments will rot in storage. Consequently, we may find that treatments receiving lower levels of nitrogen (e.g., 62 to 94 lbs per acre) produce a similar or greater number of marketable bulbs as those receiving the higher nitrogen levels. If so, reducing nitrogen levels at planting relative to the standard of 125 lbs/acre will not significantly reduce overall marketable bulb yield, but will reduce cost of nitrogen used and reduce excess nitrogen that might cause deleterious impacts on the environment. Moreover, lower levels of nitrogen will reduce thrips densities that will permit growers to use fewer insecticide applications, saving them money and reducing potential non-target effects.

BACKGROUND AND JUSTIFICATION:

Onion thrips, *Thrips tabaci* Lindeman, is the principal insect pest of onion in New York. Onions unprotected from onion thrips can suffer extensive foliar damage and high reductions in yield (**Fig. 1**). Insecticide use is the principal tactic for managing thrips, but control is becoming less effective as populations continue to develop resistance to insecticides (Shelton et al. 2003;



Fig. 1. Onion field in which a portion of the field was unprotected with insecticides and a portion that was protected with insecticides.



Fig. 2. Onion field infected with *Iris yellow spot virus* in Elba, NY.

MacIntyre-Allen 2005; Shelton et al. 2006). In addition to the difficulty of controlling thrips with insecticides, this pest has become even more problematic because it is the vector for *Iris yellow spot virus* (IYSV) (Bunyaviridae: *Tospovirus*), a virus that causes foliar damage to onion plants resulting in additional yield losses (**Fig. 2**). In the US, economic losses attributed to onion thrips and IYSV may reach \$90 million. IYSV incidence is positively correlated with onion thrips densities (Gent et al. 2006; Hsu et al. 2008). Effective control of onion thrips can reduce yield losses resulting directly from thrips feeding and indirectly due to IYSV.

Market demands for larger onion bulbs have resulted in increases in nitrogen use over the past 10 to 15 years in New York. The recommendation is to apply 125 lbs of nitrogen per acre, but there is a wide range in the amount of nitrogen added to the crop (range: 70 to 155 lbs per acre, Nault, unpublished). Some growers apply nitrogen at planting and supplement with foliar applications during the season. However, recent work in Michigan has shown that foliar-applied nitrogen will not improve bulb size or yield (Warncke 2008). In Ontario, Westerveld (2002) reported that onion yield did not differ between a conventional nitrogen treatment and one that received twice the amount of nitrogen. Other studies also have shown that there are no differences in yield when comparing different nitrogen treatments (Ells et al. 1993; Díaz-Pérez et al. 2003; Mogren et al. 2007), or that there is an optimal nitrogen level and additional nitrogen results in a decrease in yield (Islam et al. 1999, Khan et al. 2002). In addition to having a negative impact on yield, excess nitrogen can increase thrips densities (Mollema and Cole 1996; Chau et al. 2005; Broadbeck et al. 2001), increase onion bulb rot in storage (Wright 1993, Díaz-Pérez et al. 2003, Kumar 2007), increase nitrate leaching into groundwater (Ells et al. 1993), and increase nitrate in surface water near onion fields (Soil and Water Conservation District, Elba, NY). Research focused on evaluating new fertilizers to maximize onion production (Boyhan et al. 2006; Halvorson et al. 2006) generally does not include data on the impact of nitrogen treatments on pest insects, diseases and weeds.

In a preliminary study in New York in 2008, the impact of nitrogen on onion thrips populations and onion bulb yield were investigated. Onions receiving a low rate of nitrogen had the same bulb yield as onions receiving a conventional rate of nitrogen and they had significantly fewer onion thrips (Hoepting, unpublished) (**Table 1**). These data suggest that onion thrips can

Table 1. Impact of nitrogen on onion thrips and bulb yield in a field in Elba, NY, 2008.

Treatments	Soil Nitrate (ppm)		Leaf Nitrate (ppm)	Number of onion thrips per plant		Bulb Yield (lbs/25ft)
	14 May	19 June	22 July	31 July	19 August	
Conventional N	66a	74a	218a	3.9a	25.2a	40.6a
Reduced N	21b	24b	110b	1.0b	7.2b	43.8a

Means within a column followed by the same letter are not significantly different ($P>0.05$).

be reduced in onion by moderating the amount of nitrogen applied to the crop without affecting yield. If thrips populations can be lowered by manipulating nitrogen rates, infestations can be managed with fewer insecticide applications. In addition, with nitrogen costing \$0.50 to \$0.75 per pound, reducing nitrogen inputs by 50% could save growers \$40-60 per acre, or a total of \$4-8 million for the onion industry in NY (Reiners, unpublished). Growers would benefit by direct

reductions in production costs, a lower thrips population, and potentially lower rot problems in bulb storage, and the environment will benefit by reduced nitrate leaching.

The goal of this project was to reduce onion thrips infestations in onion by optimizing nitrogen inputs to the crop, while maintaining high bulb yields.

OBJECTIVES:

- 1) **Identify the optimal level of nitrogen to apply that will minimize onion thrips populations and optimize bulb yield.**
- 2) **Communicate results to growers via on-farm meetings, conferences and extension articles.**

PROCEDURES:

Objective 1. This study was conducted on a commercial onion farm in the Elba Muck near Elba, NY in 2010. Before the trial was initiated, soil samples were used to estimate the existing nitrogen, phosphorus and potassium levels. Phosphorus and potassium were applied to the whole field as needed, and individual plots received different nitrogen inputs. The form of nitrogen applied to the soil was calcium nitrate. There were six treatments that had variable amounts of nitrogen (N) (0, 50%, 60%, 75%, 100% and 150% of the recommended rate) and each treatment was replicated 8 times. Plots consisted of 4 rows and each was 15 ft long. After fertilizer had been applied, seeds of the cultivar ‘Red Bull’ were planted on 21 April. All treatments received 2 lbs of calcium nitrate at planting. All treatments were replicated 8 times. The following data were collected between May and harvest: 1) soil samples to test for available soil nitrate levels; 2) plant leaf nitrogen levels; 3) counts of onion thrips larvae per plant from 10 plants per plot (**Fig. 3**). At the end of the season, plots were harvested and bulb yield measured. Mixed-models were used to analyze all data (PROC MIXED; $P < 0.05$). Treatments were considered fixed and replication was considered random.

Objective 2. Preliminary results from this trial were disseminated to onion growers during the annual Elba Muck Twilight meeting in Elba, NY in August 2010. Results from this trial also were presented at the National Allium Research Conference in Reno, NV in December 2010.

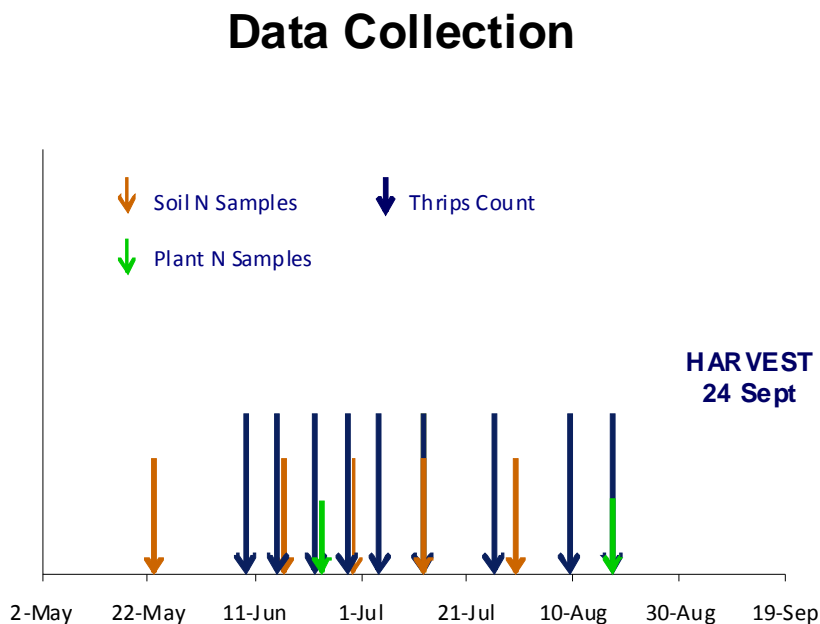


Fig. 3. Dates in which nitrogen levels were sampled from the soil and onion plants as well as when onion thrips larvae were recorded.

RESULTS AND DISCUSSION

Establishing Different Nitrogen Levels. The levels of calcium nitrate applied to the soil in April provided significant differences in the mean soil nitrate levels and plant nitrogen levels in the various treatments later in the season (**Fig. 4** and **Fig. 5**).

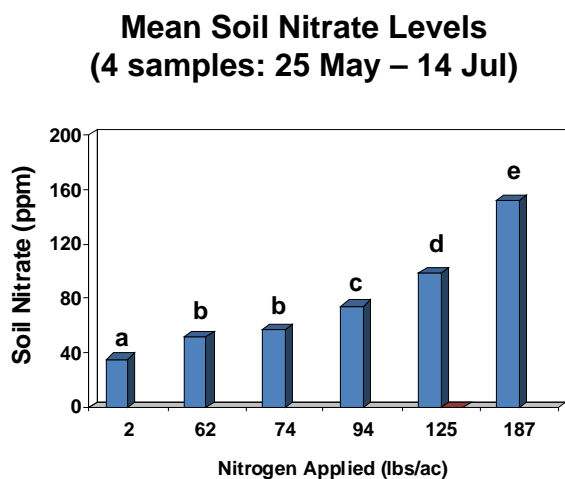


Fig. 4. Mean soil nitrate levels during the first half of the season. Means with letters in common are not significantly different ($P>0.05$).

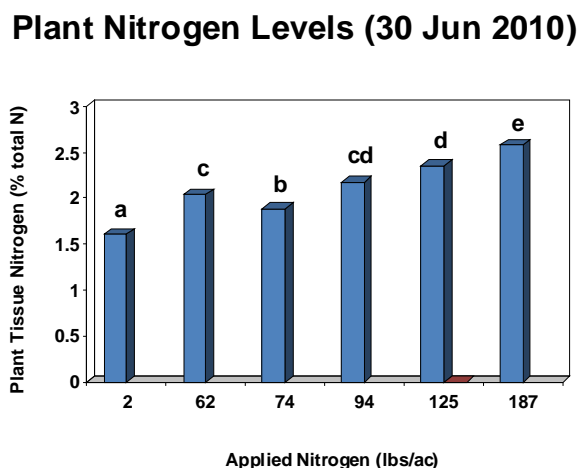


Fig. 5. Mean plant nitrogen levels during the initiation of bulbing. Means with letters in common are not significantly different ($P>0.05$).

Thrips Larval Densities. The season mean number of onion thrips larvae per plant tended to increase with increasing levels of nitrogen (**Fig. 6**). Thrips densities did not differ significantly among the 75%, 100% and 150% of the standard nitrogen treatment (125 lbs/acre). However, thrips densities were significantly lower in treatments that received “0%”, 50% and 60% of the standard amount of nitrogen (125 lbs/acre) that is currently recommended for onion production in New York (**Fig. 6**). Applying nitrogen at 62 or 74 lbs/acre rather than 125 lbs/acre reduced the season mean number of onion thrips by 15 to 33%.

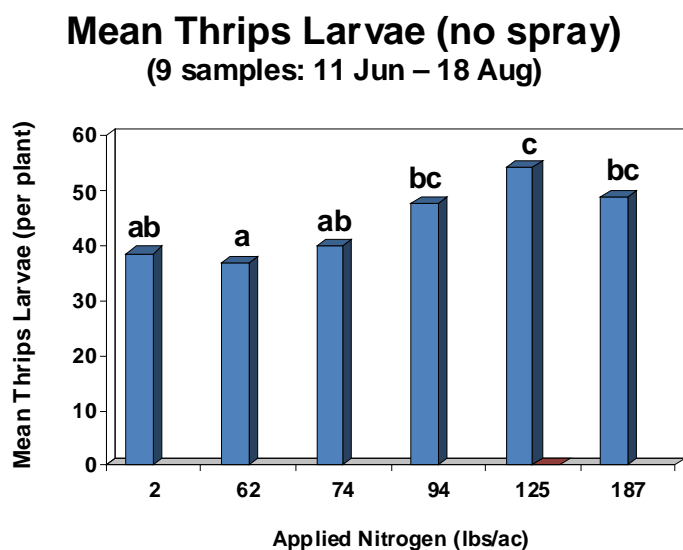


Fig. 6. Season mean number of onion thrips larvae per plant. Means with letters in common are not significantly different ($P>0.05$).

Marketable Bulb Yield. The total number of market-sized bulbs per plot at harvest tended to increase with increasing levels of nitrogen (**Fig. 7**). The greatest number of market-sized bulbs was produced in the highest nitrogen treatment, whereas similar numbers were produced in the standard treatment and the 75% of the standard treatment (**Fig. 7**). Fewer market-sized bulbs were produced in the 50% and 60% of the standard treatments and very few were produced in the “0%” treatment.

Total Market-Sized Bulbs (> 2’')

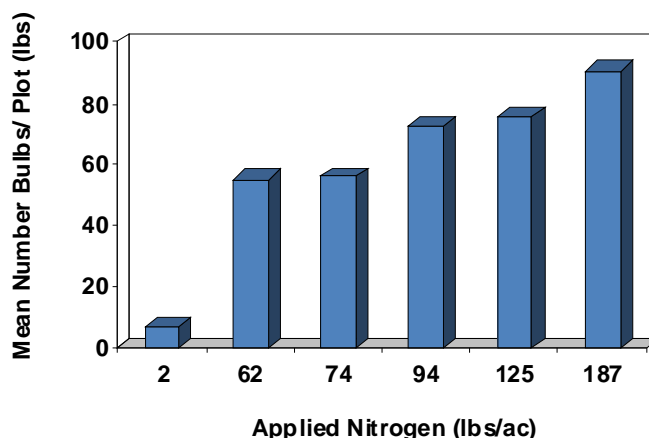


Fig. 7. The relationship between the amount of calcium nitrate applied at planting and the mean number of market-sized bulbs at harvest.

Conclusions. Our results indicate that more market-sized bulbs can be produced if high levels of nitrogen are added at planting. However, there was a positive trend between the number of rotten bulbs at harvest and the amount of nitrogen applied at planting (data not presented). Additionally, we suspect that even more market-sized bulbs in the higher nitrogen treatments will rot in storage (data to be collected in 2011). Therefore, we do not have a final assessment of the total marketable bulb yield for the treatments in this trial. The possibility exists that the greater numbers of market-sized bulbs observed in the higher nitrogen treatments at harvest will be offset by the higher levels of rot. Consequently, we may find that treatments receiving lower levels of nitrogen (e.g., 62 to 94 lbs per acre) produce a similar or greater number of marketable bulbs as those receiving the higher nitrogen levels. If so, reducing nitrogen levels at planting relative to the standard of 125 lbs/acre will not significantly reduce overall marketable bulb yield, but will reduce cost of nitrogen used and reduce excess nitrogen that might cause deleterious impacts on the environment. Moreover, lower levels of nitrogen will reduce thrips densities that will permit growers to use fewer insecticide applications, saving them money and reducing potential non-target effects.

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